OR 643/SYST 521: Network Optimization

GEORGE MASON UNIVERSITY

Systems Engineering and Operations Research Department

Fall, 2017

Time: Tuesdays, 7:20 P.m. – 10:00 p.m. (No class Oct 10th)

Classroom: Innovation Hall, Room 131

Professor: Daniel Stimpson

Phone: (703) 614-8955 (wk) from 8:30 am to 5:30 pm

(540) 834-6093 (m) from 6:30 pm to 9:00 pm

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Office hours: By appointment

Text: *Network Flows: Theory, Algorithms, and Applications*, Ahuja K. A., Magnanti T. l., Orlin J. B., Prentice Hall, 1993.

Course Description: This course is about modeling, solving, and understanding *network flow problems.* Such problems arise naturally in many disciplines such as telecommunications, transportation, electronic circuitry, and resource allocation to name a few. In addition, they can be used to solve many problems where the connection with networks is not immediately obvious (e.g., object oriented databases, accessions plans for large organizations, rapid access to closely related DNA sequences). A network formulation can provide a clear visual representation of the problem and enable efficient solution methods. The study of network flows involves concepts from optimization, complexity theory, and data structures.

There are three general topic areas covered in this course: Modeling and understanding network application areas, development of network algorithms including proofs of correctness, and computational measurements of "goodness" for such algorithms.

Computer programming skills are not a prerequisite. Resources will be provided for those not yet proficient in computer coding, but additional study time will be required to develop the necessary skills.

Course Objectives: The course focuses on the development and implementation of network flow algorithms to solve a variety of real world problems. Students will learn the terminology of graph theory and cover the fundamental ideas for solving network flow problems using specialized algorithms. Additionally, students will learn to assess the computational complexity

of algorithms routinely applied in the field of network optimization, the value of advanced data structures and their impact on improving computational complexity, and write and implement network optimization algorithms in the Python 2.7 programming language.

	Topic	Prep Work
1	Course Overview and Graph Theory	Read: Chapters 1 and 2
2	Algorithm Design and Analysis	Read: Chapter 3 (3.1 – 3.3)
3	Search Algorithms	Read: Chapter 3 (3.4, 3.6)
4	Shortest Path Problems – Part I	Read: Chapter 4
5	Shortest Path – Part II	Read: Chapter 5 (5.1 – 5.6, and 5.8)
6	Maximum Flow – Part I	Read: Chapter 6 (6.1 – 6.5, 6.7, and 6.8)
7	Maximum Flow – Part II	Read: Chapter 7 (7.1 – 7.4, 7.6, 7.7, 7.9, 7.10)
8	Maximum Flow – Part III	Review: Chapter 7 (7.1 – 7.4, 7.6, 7.7, 7.9, 7.10)
9	Minimum Cost Flow – Part I	Read: Chapter 9 (9.1 – 9.9, and 9.12)
10	Minimum Cost Flow – Part II	Review: Chapter 9 (9.1 – 9.9, and 9.12)
11	Assignments and Matchings	Read: Chapter 12 (12.1 – 12.5)
12	Minimum Spanning Trees	Read: Chapter 13 (13.1 – 13.6, 13.9)
13	Network Simplex	Read: Chapter 11 (11.1 – 11.6)
14	Special Topics	

Course Software: Python 2.7 will be used to implement a variety of graph algorithms. Continuum Analytics' Anaconda distribution of Python 2.7 is the recommended programming environment. For homework credit, assignments must run in this environment. This freeware is available at: https://www.continuum.io/downloads.

Lectures and Reading: Students are expected to prepare for, attend, and participate in course lectures. Most reading assignments will be from the required text, but additional readings may be assigned also.

Homework: Homework is a valuable part of the learning process, especially in developing skills of independent study and in reinforcing and extending concepts covered in class. There will be regular problem sets assigned. Students are encouraged to work together, but each student must write up his/her solutions independently.

Project: A project related to the course material and involving programming will be required. This will be done in groups of 2 or 3 on a on a topic of your group's choosing. This work will be presented orally to the class.

The purpose of the project is to apply the concepts and techniques learned in this class to a realistic network problem. Your analysis and solution should involve applying a combination of the techniques we will study.

Quizzes: There will be several in-class quizzes covering the material presented in class, in reading assignments, and in homework assignments.

Grading:

Homework	30%
Quizes	30%
Project	30%
Class Participation	10%

Academic Integrity: Students are responsible for their own work. Students must adhere to the guidelines of the George Mason University Honor Code.

MasonLive/Email (GMU Email): Students are responsible for the content of university communications sent to their George Mason University email account and must activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students through their Mason email account.